Alternative Geotextile Fabric

PREPARED FOR: de maximis, inc.

COPY TO: File

PREPARED BY: CH2M HILL

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PROJECT NUMBER: 474468.RA.PM.01

Introduction

Following installation of the sand/AquaGate+PAC^{TM} layer, a single layer of a non-woven 100% plastic high strength dimensionally stable geotextile is to be installed. This geotextile was originally planned to be placed in single roll panels. However, the tidal and current conditions of the river have made the placement of single panels difficult. Therefore, it was proposed that the geotextile be sewn into panels 2 to 3 rolls wide prior to placement. This alternate approach will require the use of a alternate geotextile fabric that meets the specifications. The purpose of this technical memorandum is demonstrate that the alternate geotextile meets the requirements of Section 2320 Capping of the technical specifications.

Geotextile Properties and Applicable Standards

Table 1 provides a comparison of the currently approved geotextile fabric (SKAPS GE-112) and the proposed alternate fabric (Crown E-120) against the requirements of the technical specification. The capping technical specification (Section 02 32 00) and the specification sheets for each of the geotextile fabrics are included as Attachments 1 and 2, respectively.

Table 1 – Summary of Physical Testing Results

Property[a]	ASTM	Units	Technical Specification Requirement[b]	SKAPS	Crown E-120
Grab Strength	D 4632	N	1,400	1,470	1,560
Sewn Seam Strength[c]	D 4632	N	1,260	NA	1,260
Trapezoidal Tear Strength	D 4533	N	500	556	556
Puncture Strength	D 6241	N	2,750	4,000	4,000
Permittivity[d]	D 4491	sec^{-1}	0.5	0.90	0.76
AOS[d.e]	D 4751	mm	0.5	0.15	0.15

UV stability (retained strength)[f]	D 4355	%	50	70	70

AOS, apparent opening size; UV, ultraviolet; N, newton; mm, millimeter; sec, second.
[a] AASHTO Standard Specification M 288, Type 1 geotextile for erosion control, separation, and survivability.
[b] Minimum Average Roll Value in weaker principal direction per Section 023200, except as noted otherwise.
[c] If sewn seams required; otherwise overlap.
[d] AOS and Permittivity are perpendicular to plane of geotextile.
[e] AOS is maximum size allowed.
[f] After 500 hours

Conclusions and Recommendations

The proposed alternate geotextile fabric meets all the requirements of the capping technical specifications and is therefore considered acceptable for use for the RM 10.9 cap.

Attachment #1

Capping Technical Specification

SECTION 02 32 00
SEDIMENT CAPPING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C33, Standard Specification for Concrete Aggregates.
   b. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   c. C127, Standard Test Method for Density, Relation Density (Specific Gravity), and Absorption of Coarse Aggregate.
   d. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C295, Standard Guide for Petrographic Examination of Aggregates for Concrete.
   f. D75, Standard Practice for Sampling Aggregates.
   g. D638, Standard Test Method for Tensile Properties of Plastics
   h. D854, Standard Test Methods for Specific Gravity of Soil Solids by Water Pycnometer.
   i. D3776/D3776M, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
   j. D4355, Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in Xenon Arc Type Apparatus.
   k. D4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   l. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   m. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   n. D4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile
   o. D4992, Standard Practice for Evaluation of Rock to be Used for Erosion Control.
   p. D5312, Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Freezing and Thawing Conditions.
   q. D5313, Standard Test Method for Evaluation of Durability of Rock for Erosion Control Under Wetting and Drying Conditions.
   r. D5519, Standard Test Methods for Particle size Analysis of Natural and Man-Made Riprap Materials.
   s. D6241, Standard Test Method for the Static Puncture Strength of Geotextile and Geotextile-Related Products Using a 50-mm Probe.

2. AASHTO
   a. M 288, Standard Specification for Geotextile Specification for Highway Applications.

1.02 DEFINITIONS

A. Sand Material: Clean sand material that will be placed on top of the newly dredged sediment surface as part of a combined sand/active material layer and on top of the armor stone as a habitat layer.

B. Active Material: AquaGate+PAC™ activated carbon. The active material will be placed with clean sand material to form a uniformly mixed sand/active material layer.

C. Geotextile Material: Permeable non-woven geosynthetic filter fabric that will be placed on top of the active layer.

D. Armor Material: Hard, angular stone that will be placed on top of the geotextile material for erosion protection.

E. Low-Energy Placement: Placement of granular material (active material, sand material, armor material) resulting in low-energy of the material as it impacts the river substrate by controlling the mass rate and velocity of the material delivery.

1. Acceptable methods for low-energy placement of sand and active materials, if shown to meet the environmental and physical tolerances of this Section, include the use of sand/salt broadcast spreaders, conveyor systems, hydraulic pumping and placement with the use of diffusers or tremies.

2. Acceptable methods for low-energy placement of armor stone include the excavator bucket or clamshell release of material just above the receiving layer surface, minimizing the drop height (free fall) and material mounding as further specified in this Section.

3. Bottom or belly dumping from floating vessels, submerged clamshell releases (for sand and active material), washing of materials from barges, mounding of material on river substrate and subsequent spreading, are prohibited.

1.03 SUBMITTALS

A. Submittals Prior to Construction. Submit the following plans and include specific equipment proposed for material handling and low-energy placement, where applicable, including anticipated long- and short-term storage methods and locations, land-side delivery, placement sequence, placement rates (volume per unit time) and means and methods to verify placement of each capping layer.

1. Sand/Active Material Placement Plan: Plan describing transport, delivery, transferring and
low-energy placement of the combined sand/active material. Include gradation test data and active material manufacturer specification sheets.
2. Geotextile Placement Plan: Plan describing transport, delivery, transferring and placement of geotextile material. Include manufacturer material specification sheets.
3. Armor Placement Plan: Plan describing transport, delivery, transferring and placement of armor materials. Include gradation and other specified physical test data.
4. Sand Habitat Layer Placement Plan: Plan describing transport, delivery, transferring and placement of the sand habitat layer. Include gradation test data.
5. Storm Water Pollution Prevention Plan which describing means and methods and best management practices to be utilized for keeping stockpile areas free of water, debris, and foreign material during storage handling and placement of materials.

B. Informational Submittals: Performance data from past projects using similar equipment and technologies.

PART 2 - PRODUCTS

2.01 SAND MATERIAL

A. The sand portion of the combined sand/active material layer shall be a maximum average of 70 percent by volume and a maximum of 75 percent by volume. The sand habitat layer shall be sufficient to cover the armor stone and form a smooth final cap surface. The sand material shall be medium to coarse sand (USCS Classification SW or SP) with no more than 1 percent passing the Number 200 sieve (P200). Clean, hard, durable imported material, free from foreign materials. Specific gravity as determined in accordance with ASTM C127 and ASTM D854: 2.5 minimum. Gradation as determined in accordance with ASTM C117 and ASTM C136:

Sieve Size	% Passing
3/8 in.	100
#4	95–100
#8	80–100
#16	50–85
#30	25–60

Sieve Size	% Passing
#50	10–30
#100	2–10
#200[a]	0–1

[a]Specification for passing #200 sieve reduced from 0 to 3 percent for ASTM C33 Fine Aggregate to 0 to 1 percent.

2.02 ACTIVE MATERIAL

A. The active material shall be placed as a uniform mixture within the sand layer and consist of a minimum average of 30 percent by volume and a minimum of 25 percent by volume of AquaGate+PAC™ as manufactured by AquaBlok, Ltd.

1. Physical Properties of AquaGate+PAC™ are as follows:
   a. Activated carbon by weight: 10%
   b. Dry Bulk Density: 60 to 70 lbs/ft3
   c. Settling velocity of standard AquaGate+PAC™: 15 cm/s

B. Active materials will be placed in strict accordance with the type, manufacturer, sequence, and thickness specified in this Section unless otherwise approved by CH2M HILL prior to construction.

C. Where applicable Matt Grab strength testing results shall be provided prior to construction.

2.03 ARMOR MATERIAL

A. Clean, hard, angular, durable imported material that is free from foreign materials.

B. Perform evaluation tests on stone samples collected from the proposed source under the direction of a registered geologist or registered engineer. The tests to which the stone shall be subjected include petrographic examination (ASTM C 295), bulk specific gravity (SSD), absorption (ASTM C 127), resistance of stone to freezing and thawing (ASTM D 5312), and if argillaceous limestone and sandstone are used, resistance to wetting and drying (ASTM D 5313) to meet the following requirements.

1. Bulk specific gravity (SSD) > 2.65
2. Absorption < 2 percent
3. Resistance to Freezing and Thawing, maximum loss < 10 percent
4. Resistance to Wetting and Drying, maximum loss < 1 percent

C. Gradation to be determined in accordance with ASTM D5519.

D. Provide Armor Material to an average thickness of 12 inches and a minimum thickness of 10 inches as shown on the plans.

Limits of Stone Weight (lb) for Percentage Lighter by Weight					
100		50		15	
Max.	Min.	Max.	Min.	Max.	Min.
23	9	7	5	3	1

2.04 GEOTEXTILE

A. Nonwoven 100 percent plastic high-strength dimensionally stable filter fabric.

B. Opening size, permittivity, UV resistance, and strength properties meet applicable standards as given below.

Geotextile Properties and Applicable Standards

Property[a]	Test Method	Units	MARV[b]
Grab Strength	ASTM D 4632	N	1400
Sewn Seam Strength[c]	ASTM D 4632	N	1260
Trapezoidal Tear Strength	ASTM D 4533	N	500
Puncture Strength	ASTM D 6241	N	2750
Permittivity	ASTM D 4491	sec^{-1}	0.5[d]
AOS	ASTM D 4751	mm	0.5[d,e]
UV stability (retained strength)	ASTM D 4355	percent	50 (after 500 hours)

AOS, apparent opening size; UV, ultraviolet; N, newton; mm, millimeter; sec, second.
[a] AASHTO Standard Specification M 288, Type 1 geotextile for erosion control, separation, and survivability.
[b] Minimum Average Roll Value in weaker principal direction, except as noted otherwise.
[c] If sewn seams required; otherwise overlap.
[d] AOS and Permittivity are perpendicular to plane of geotextile.
[e] AOS is maximum size allowed.

2.05 SOURCE AND QUALITY ASSURANCE

A. Subcontractor shall provide the results of one representative gradation test (ASTM D2487) per 1,000 cubic yards from the sand source prior to the delivery of the sand to the site. Subcontractor shall also perform chemical analyses of sand material according to the certification and testing requirements established by the USEPA to certify the material meets requirements prior to placement of the sand cover. These analytical testing include:

1. TAL metals (excluding mercury) and titanium using EPA Method 6010C/6020A
2. SVOCs using EPA Method 8270C
3. PAHs and alkyl PAHs using a laboratory-specific SOP based on California EPA Air Resources Board Method 429 and NOAA ORCA 130 Method
4. PCBs (homologs and congeners) using EPA Method 1668A
5. PCDDs/PCDFs using EPA Method 1613B
6. Organochlorine pesticides using a laboratory-specific SOP based on USEPA Method 1699
7. Chlorinated herbicides using EPA Method 8151A
8. TPHs (extractable) using NJDEP Method OQA-QAM-025-02/08
9. Butyltins using a laboratory-specific SOP based on Krone 1988
10. Mercury, low-level using EPA Method 1631
11. Cyanide using EPA Method 335.2
12. VOCs using EPA Method 8260B

B. Subcontractor shall also perform chemical analyses of sand material in accordance with N.J.A.C. 7:26E. Project-specific samples shall be collected and analyzed for the full TCL/TAL/metal suite.

C. Subcontractor must receive the approval from CH2M HILL prior to delivery and placement of the sand.

D. Subcontractor shall provide the results of testing of the armor stone source prior to the delivery of the stone to the site.

1. One representative series of evaluation tests specified in this Section per armor stone (riprap) source.
2. One representative gradation test (ASTM D5519) per 3,000 tons from the armor stone (riprap) source.

E. Subcontractor shall provide geotextile and active material manufacturer specifications and product literature including certification that furnished products have specified property values prior to the delivery to the site.

PART 3 – EXECUTION

3.01 GENERAL

A. Keep stockpile areas free of water, debris, and foreign material during storage handling and placement of materials. Provide storm water protection of material stockpiles in accordance BMPs described in the Storm Water Pollution Prevention Plan.

B. Place sand/active and bulk active materials using approved low-energy placement methods consisting of a conveyor/broadcast spreader system or a conveyor/diffuser system, or similar method of accurately placing a measured amount of material to a uniform thickness through the water column. Minimize

resuspension and mixing of in situ sediments or previously placed materials. Methods shall enable the material to be placed to the tolerances required in this Specification.

C. Tolerances:

1. Final Lines and Grades: Materials shall be placed to the dimensions shown or specified otherwise as follows:
   a. For the combined sand/active materials, the average thickness shall be 10 inches with a minimum thickness of 8 inches.
   b. For geotextile, place within a horizontal tolerance of 1.0 foot. Overlaps shall be a minimum of 18 inches for geotextile.
   c. For armor materials, within a horizontal tolerance of 2.0 feet, an average thickness of 12 inches, and a minimum thickness of 10 inches, except that no armor stone will be allowed within the shipping channel.
   d. For sand habitat material, cover the armor stone so that the final cap has a smooth surface.
2. Placement tolerances will be monitored and verified by CH2M HILL after each material is placed. Subcontractor shall complete corrective measures prior to placement of the next successive material.

D. Coordinate placement of capping materials with:

1. Placement of sampling and monitoring devices required for Subcontractor's Quality Control Plan prior to and during installation of capping materials;
2. Placement of sampling and monitoring devices required by CH2M HILL's Sampling and Analysis Plan (SAP) and/or Quality Assurance Plan (QAP).

E. In the event that the capping materials slough into the Federal Navigational Channel due to the design, the Subcontractor shall remove the sloughed material.

3.02 SAND AND ACTIVE MATERIAL PLACEMENT

A. Place clean sand and active material to the specified thickness over the sediment surface as shown on the plans so that the active material and sand form a combined uniformly mixed layer upon placement.

B. Place clean sand habitat layer to cover the armor stone.

C. Following placement, measurements will be performed by the Subcontractor in accordance with QC requirements to confirm that the thickness of the material placement is within specified tolerances.

D. Place material in such a manner as to minimize resuspension of sediments and to minimize turbidity caused by the placement techniques.

E. Subcontractor will not be reimbursed for placement of materials beyond tolerances.

3.03 GEOTEXTILE PLACEMENT

A. Use spreader bars or slings to unload, lift, move, store and deploy rolls in accordance with manufacturer's instructions and without damaging the material.

B. Orient geotextile with long (unrolled) direction perpendicular to shoreline.

C. Avoid damage to the bottom surface of the geotextile/RCM when moving across ground.

D. Spuds must not be placed on the geotextile.

E. All geotextile panels shall be installed flat, with no wrinkles or folds.

F. Secure geotextile during installation as necessary with sand bags or other means approved by CH2M HILL.

G. End-of-panel overlaps shall be sewn, stapled or hog-ringed along each side of a 1foot overlap.

H. Do not place successive layer(s) on top of geotextile until CH2M HILL provides authorization to proceed.

I. If tears, punctures, or other geotextile damage occurs during placement of geotextile or successive materials, remove overlying products as necessary to expose the damaged geotextile material and repair or replace as directed.

3.04 ARMOR PLACEMENT

A. Armor stone shall be carefully placed by mechanical means directly on the geotextile to avoid tears and punctures and disturbance of the geotextile material.

B. Do not allow armor stone to drop more than one foot free fall above water nor more than two foot free fall below water.

C. Armor stone shall be handled so that the stone size distribution of each load placed is representative of the specified armor stone gradation.

D. Armor stone shall be placed so it is not mounded to a thickness greater than the specified layer thickness.

3.05 QUALITY CONTROL TESTING

A. General: Subcontractor will be required to monitor properties and placement of completed work in accordance with the Construction Quality Control Plan. Specific testing requirements include the following:

B. Material Properties

1. Gradation of sand and armor materials as placed.

C. Material Placement

1. Tolerances: horizontal and vertical via cores for sand and active layers and settlement plates for armor layers. Post-construction surveys via bathymetric surveys and, as needed, poling or coring for verification of coverage.

D. The placement accuracy for and tolerance specifications of the sand, active and armor layers will have been satisfied when the following statistical criterion is demonstrated based on post-sand layer, post-active layer, post-armor layer and post-habitat layer placement measurements to be conducted by CH2M HILL:

Number of Samples Needed to Document Attainment of Minimum Thickness Requirement

Number of Samples Collected	Number of Samples Needed to Exceed Minimum Thickness	Number of Samples Collected	Number of Samples Needed to Exceed Minimum Thickness
11	11	21	20
12	12	22	21
13	13	23	22
14	14	24	23
15	15	25	23
16	16	26	24
17	17	27	25
18	17	28	26
19	18	29	27
20	19	30	28

Cap Layer Thickness Requirements

Cap Layer	Minimum Thickness (inches)	Minimum Average Thickness (inches)	Maximum Average Thickness (inches)
Combined Sand/Active	8	10	
Armor	10	12	
Habitat	Cover armor stone		
Total Cap Layers (Combined Sand/Active + Armor + Habitat)			24

END OF SECTION

Attachment #2

Geotextile Fabric Technical Specifications

Crown Resources

2694 Hayes Wilbank Road
Toccoa, GA 30577
(864)968-0592

Geotextile Product Description Sheet

Style E120

E120 is a nonwoven geotextile produced by needlepunching synthetic staple fibers in a random network to form a high strength dimensionally stable fabric. The polypropylene fibers are specially formulated to resist ultraviolet light deterioration, and are inert to commonly encountered soil chemicals. The fabric will not rot or mildew, is non-biodegradable, and is resistant to damage from insects and rodents. Polypropylene is stable within a ph range of 2 to 13. E120 conforms to the physical property values listed below:

Fabric Property	Test Method	Units	Minimum Average Roll Value
Weight	ASTM D 5261	oz/sq.yd.	12.0 (408 g/sm)
Thickness*	ASTM D 5199	Mils	120 (3.05 mm)
Grab Tensile	ASTM D 4632	lbs.	350 (1.56 kN)
Grab Elongation	ASTM D 4632	%	50
Trap Tear	ASTM D 4533	lbs.	125 (.556 kN)
CBR Puncture	ASTM D 6241	Lbs	900 (4.0 kN)
Permittivity*	ASTM D 4491	1/sec	0.758
AOS	ASTM D 4751	U.S. Sieve	100 (.150 mm)
Permeability*	ASTM D 4491	cm/sec	.30
Water Flow*	ASTM D 4491	gpm/sqft	60 (2290 1/min/sm)
UV Resistance after 500 hrs.	ASTM D 4355	% Strength Retained	70
Packaging			
Roll Dimensions-Feet			15 x 480
Square Yards Per Roll			800
Estimated Roll Weight-Lbs.			620

* At time of manufacturing, handling may change these properties.

2012

January 3, 2014

IWT Cargo guard
Attn: Pete Daly

Pete,

Terra Marine Geo Products is an authorized distributor and converter of seamed panels for Crown Resources. The Crown Resources E120 roll goods will be converted to sewn panels per the spreadsheet received with dimensions for North Zone Panels N1 thru 40 and South Zone S1 thru 31. Terra Marine Geo Products will convert sewn panels of (E120) 12 oz non-woven geotextile sewing method double lock stich meeting the 1260 N per ASTM 4632.

Please let me know if you have any questions.

Michael Geis
Operations Manager
TerraMarine Geo, LLC

Sales Office:
Engineered Synthetic Products, Inc.
Tel (770) 564-1857
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www.espgeosynthetics.com

Geotextile Product Description Sheet
SKAPS GE-112
Nonwoven Geotextile

SKAPS GE-112 is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibers, which are formed into a random network for dimensional stability. SKAPS GE-112 resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. SKAPS GE-112 conforms to the physical property values listed below:

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight	ASTM D 5261	oz/yd^2 (g/m^2)	12.0 (407)
Grab Tensile	ASTM D 4632	lbs (kN)	330(1.47)
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	lbs (kN)	125(0.556)
Thickness*	ASTM D 5199	mils (mm)	120(3.05)
Puncture Resistance	ASTM D 4833	lbs (kN)	190 (0.844)
CBR Puncture Resistance	ASTM D 6241	lbs (kN)	900 (4.0)
Mullen Burst Strength	ASTM D 3786	psi (kPa)	625 (4306)
Permittivity*	ASTM D 4491	sec^{-1}	0.90
Permeabililty*	ASTM D 4491	cm/sec	0.3
Water Flow*	ASTM D 4491	gpm/ft^2(l/min/m^2)	70 (2544)
AOS	ASTM D 4751	US Sieve (mm)	100 (0.150)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – ft	15 x 480
Square Yards Per Roll	800
Estimated Roll Weight – lbs	620

* At the time of manufacturing. Handling may change these properties.

This information is provided for reference purposes only and is not intended as a warranty or guarantee. SKAPS assumes no liability in connection with the use of this information.

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Made in U.S.A.

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